Journal of Economic Dynamics & Control 57 (2015) 132–144

Contents lists available at ScienceDirect

Journal of Economic Dynamics & Control

journal homepage: www.elsevier.com/locate/jedc

Measuring the welfare costs of inflation in a life-cycle model ☆

Paul Gomme [a,b,*]

[a] Department of Economics, Concordia University, 1455 de Maisonneuve Blvd. West, Montreal, QC, Canada H3G 1M8
[b] CIREQ, Canada

ARTICLE INFO

Article history:
Received 10 November 2014
Received in revised form
1 May 2015
Accepted 2 June 2015
Available online 7 June 2015

JEL classification:
E52
E31
E32
D58
D91

Keywords:
Monetary policy
Inflation
Welfare costs
Life-cycle model

ABSTRACT

In a neoclassical growth model with life-cycle households in which money is held to satisfy a cash-in-advance constraint, the optimal steady state inflation rate is absurdly high: in excess of 20%. Lump-sum, age-independent money injections twist and flatten the lifetime profile of utility, making this profile look more like the one that would be chosen by a planner. The cost of monetary finance of lump-sum payments is the distortion introduced to the labor-leisure choice.

1. Introduction

Following Cooley and Hansen (1989), there is an extensive literature assessing the quantitative costs of inflation, and the optimality of the Friedman rule in the context of infinitely lived, representative agent models. How are these results affected by switching to a life-cycle model? For the specific model analyzed in this paper – a life-cycle version of the Cooley and Hansen (1989) – the optimal inflation rate (the one maximizing steady state lifetime utility of a newborn) is ridiculously high – over 20%. While inflation introduces a distortion to individuals' decisions, it also serves a redistributive role. Before giving some intuition for the model's results, it will help us to outline its key features.

First, as in Cooley and Hansen (1989), money is held in order to satisfy a cash-in-advance constraint on purchases of the consumption good. Second, as is common in the monetary literature, money injections occur via lump-sum transfers (so-called helicopter drops of money). Third, individuals live exactly T periods; there is no random death. Fourth, individuals start life with no capital (real assets), and must end their lives with non-negative capital holdings. Since there is no bequest

☆ This project was funded, in part, by the Social Sciences and Humanities Council (410-207-1171) and the Fonds Québécois de la Recherche sur la Société et la Culture (2012-SE-144688). Work on this project was initiated while the author was employed at the Federal Reserve Bank of Cleveland. The views expressed herein do not necessarily reflect those of the Federal Reserve Bank of Cleveland or of the Federal Reserve System.

* Correspondence address: Department of Economics, Concordia University, 1455 de Maisonneuve Blvd. West, Montreal, QC, Canada H3G 1M8. Tel.: +1 514 848-2424x3934; fax: +1 514 848 4536.
E-mail address: paul.gomme@concordia.ca

http://dx.doi.org/10.1016/j.jedc.2015.06.002
0165-1889/

motive, individuals will, in fact, end life with no capital. Between birth and death, individual are unconstrained with respect to their capital holdings, and so *may* go into debt if they wish. Finally, individuals start life with some real money balances. This feature is included so that there is not a 'trivial' reason for inflation to be welfare-improving: suppose individuals have no initial real balances, then if there is no lump-sum transfer of money balances, the cash-in-advance constraint implies that individuals would be unable to purchase consumption in the first period of their lives. So that money is not simply created "out of thin air," it is assumed that agents end life with the same level of real balances with which they started.[1]

Why is the optimal steady state inflation rate so high? A key feature of the calibrated model is that utility increases with age; when utility is separable between consumption and leisure, both consumption and leisure also increase with age.[2] The cash-in-advance constraint implies that, in order to finance this increasing profile for consumption, real money balances must also rise with age. Inflation acts as a tax on old, rich agents, and the lump-sum injections of money transfer resources to young, poor agents. To understand why households prefer a flatter age-utility profile, consider the problem of a planner who maximizes a weighted sum of utility of all generations, including the unborn; this problem is discussed in more detail in Section 4. If the planner discounts each generation's lifetime utility using the same discount factor used by households, then the steady state profiles for utility, consumption and leisure are all constant provided preferences are separable between consumption and leisure. In other words, at least in steady state, flatter age-profiles for consumption, leisure and utility are desirable.

However, inflation introduces a distortion to the labor-leisure choice owing to the fact that current income cannot be spent on consumption goods in the same period in which the income is earned. There are, then, two effects associated with inflationary finance of lump-sum injections of money: (1) the flatter age-utility profile which raises steady state lifetime utility of the newly born, and (2) the distortions to the labor-leisure choice. For the calibrated model, the first effect dominates up to an annual inflation rate of 23%. However, the welfare gain associated with such an extreme inflation rate is quite modest – around 0.1% of consumption.

The intuition underlying the above results is summarized in Fig. 1. In order to produce a relatively simple figure, the rich life-cycle structure of the model is reduced to consumption when young and consumption when old, and leisure is suppressed. Point *A*, corresponding to the non-monetary allocation, reflects the observation that in the model, consumption is rising with age. Point *B*, the 23% steady state, is obtained as follows. First, the combination of high inflation and associated lump-sum transfers rotates the budget line since this higher inflation rate is associated with higher consumption when young, and lower consumption when old. Second, the budget line shifts in reflecting the deleterious effects of inflation on hours worked. As drawn, the new steady state consumption allocation places households on a higher indifference curve.

The model's results are driven by the fact that consumption, leisure and utility all increase with age. To understand why consumption rises over the life-cycle, it is easier to consider the non-monetary version of the model. When consumption and leisure are separable in preferences, as they are in the model, the intertemporal Euler equation governing real asset accumulation relates the growth rate of consumption over the life-cycle to the product of the discount factor and the gross real interest rate. The model is calibrated to a conventional value of the real interest rate, 4% per annum. The resulting value for the discount factor implies that the aforementioned product is greater than one, and so consumption rises with age. The intratemporal Euler equation then delivers a rising pattern to leisure, and finally utility.

Fig. 1 also helps us to explain why households do not achieve a greater degree of utility smoothing on their own. After all, households are free to go into debt. However, if they do so, they need to repay that debt at the real interest rate – in steady state, 4% per annum. The government, though, faces more of a one-for-one trade-off between young and old consumption. Roughly speaking, private households face a budget constraint associated with point *A* while the government faces a feasibility constraint associated with point *B*.

While steady state utility is higher, as shown in Fig. 1, the high inflation allocation is not Pareto superior to the non-monetary allocation. Since the monetary allocation transfers resources from old households to young ones, the initial old would be made worse off in transitioning to the monetary allocation.

Further support for the central result in this paper, that the redistributive effects of inflation may outweigh the distortionary effects, can be obtained by analyzing a version of the model with consumption and income taxes. With these alternative sources of government revenue in place, the steady state lifetime utility-maximizing inflation rate is essentially that prescribed by the Friedman rule: minus the real interest rate. In other words, with these other taxes in place, there is no role for further intergenerational transfers of resources and inflation only serves to further distort agents' decisions. Perhaps the reason why the tension between the distortions associated with taxes and their intergenerational redistributive role has not previously arisen is because current U.S. taxes are sufficiently high that redistribution is not an issue.

An earlier strand in the literature, exemplified by Weiss (1980) and Bhattacharya et al. (2005), used the two period overlapping generations model to discuss the welfare properties of alternative money growth rates. Weiss (1980) considers a production economy in which money demand arises owing to money-in-the-utility function. In his model, lowering the return to money (raising inflation) leads to a substitution from real balances to capital, raising the real wage rate and lowering the real return to capital. Weiss (1980) shows that if the interest rate exceeds the growth rate, such effects have

[1] The lifetime maximizing inflation rate is a few percentage points *higher* if the initial money balances are financed through a lump-sum tax on *all* agents. Otherwise, the model results are essentially the same.

[2] That utility and consumption rise with age is related to the relationship between the marginal rate of substitution for goods over time, and real returns. This point is discussed in detail later in this Introduction.